Course title

Advanced Technician for composite materials and 3D printing

Course profile

Advanced Technicians for composite materials and 3D printing work in the design and industrialization of innovative products made with advanced composite materials, innovative molding and polymerization technologies. This is carried out by molding and additive manufacturing technologies (laser, electron beam) and three-dimensional molding. They use simulation technologies for forming molds, drawing and CAD modeling processes and CNC programming. Technicians form part of companies that design, simulate, develop, test and manufacture innovative products for functional applications required in the auto-motorbike industry (from motorsport to road production), aeronautics, aerospace, renewable energy, industrial plant sectors, in the improvement of performance, sustainability and safety (reduction of masses and weight, of the energy dispersed in friction, reduction of noise, improvement of fatigue and impact resistance, processing flexibility).

Organization (main teaching, training and verification methodologies)

The main learning activities include:

- General courses in linguistic, communicative, relational, scientific, technological, legal, economic, organizational and managerial fields;
- Teachings of a technical-professional nature both common to the reference area (Made in Italy Technologies - Mechanical System) and specialist/distinctive of the profile.

The course is carried out in 2 full-time annuities, which constitute a student workload total of 1,500 hours.

The workload includes all the training methods:

- In the classroom;
- In didactic laboratories in offices equipped with software, systems and tools for exercises and checks, also installed at member companies/partners;
- Project Work/Research Project;
- Internship;
- Individual study.

Most of the teaching hours are entrusted to member companies or partners, who provide experts and/or in the company setting with related technological equipment, laboratories, plants and technical documentation.

40% of the work takes place in the company through an internship and establishing a strong link in the production fields.

Guided visits are also provided to leading companies and to laboratories and research centres both in and outside the Region. Visits to events or fairs abroad may also be possible.

Methodologies and verification criteria

At the end of the course there will be a final exam for the release of the Advanced Technician diploma.

The assessment of learning outcomes is also carried out at the end of each training unit, with the following criterion:

- Practical exercises to verify and evaluate the learning outcomes of the training units which provide for the prevalence of active and laboratory teaching methodologies and/or learning focused on the technologies in use;
- Written exercises to verify and evaluate the learning outcomes in theoretical training units which involve the use of traditional teaching methods.

Disciplinary area of reference (ISCED - F)

0715 Mechanics and metal trades

Job title (national classification/standard)

Advanced technician for the innovation of processes and mechanical products

Level

QF - EHEA: short cycle qualification

EQF: level 5

Total ECTS credits

120

Learning outcomes of the study course

At the end of the training path the student will be able to:

- Manage communication and relational processes within and outside the organization both in Italian and in English;
- Master the linguistic tools and information and communication technologies to interact in the workplace;
- Arrange, negotiate and develop activities in working groups to tackle problems, propose solutions, help in production, order and evaluate collective results;
- Organize and use information, data and their aggregations;
- Use statistical tools and models in the description and simulation of the different scenarios of the reference area;
- Develop and implement design, prototyping and industrialization techniques;
- Intervene in all segments of the supply chain from production to marketing;
- Manage production flows in programming, control and cost-effectiveness, also in relation to the methods of industrialization and continuous improvement;
- Configure, calibrate, document and maintain automatic systems of different types;
- Recognize the characteristics and properties of composite materials for the creation of innovative products;
- Identify the materials, relative processes and treatments suitable for the various uses in the additive manufacturing processes;
- Use simulation technologies for mold forming, drawing and CAD modeling of molds and CNC programming for execution;
- Use additive manufacturing technologies (laser, electron beam) and three-dimensional molding.

Year I

Area/ Range	Competence objectives for national classification/standard	Module	Main contents	Learning outcomes of the unit	Methods and criteria for verifying results	Learning methodologies, contexts and related workload (hours)	ECTS credits
General Linguistic, communicative and relational field	Master the linguistic tools and information and communication technologies to interact in daily activities and at work.	Office automation	Computer applications for office automation and the processing of data and information.	Be able to use Microsoft Office IT applications independently and skilfully.	Method: PC practice test Criteria: The student will have to demonstrate the use of Microsoft Office applications	Classroom / laboratory: 20 hours Individual study: 20 hours	1,5
		Digital tools for collaborative work, presentation and communication	Fundamental assets of collaborative work tools: speed, accessibility, usability, sharing and security. E-mail as a contact and repository tool (risks and opportunities). Mobile and multi-channel work (access to content from PC, notebook, smartphone or tablet). Collaborative exchange applications (video collaboration platforms, Whatsapp, WeTransfer and Skype). Transparent and traceable management tools for company workflows: technological solutions for the convergence of office automation, document management and management systems (co-editing, self-service analytics, personal archiving). Platforms and web promotion tools (Facebook Ads, Google AdWords) and organic positioning and search engine optimization (SEO).	Know how to use online collaboration tools. Know how to use presentation and communication tools. Know how to intervene in digital communication activities: digital marketing, positioning and optimization on search engines (SEO).	Method: PC practice test. Criteria: The student must demonstrate the use of online collaboration tools and/or presentation and communication.	Classroom / laboratory: 16 hours Individual study: 14 hours	1

	Use technical English (micro language), related to the technological area of reference, to communicate correctly and effectively in the contexts in which is required. Manage the communication and relational processes inside and outside the organization both in Italian and English.	Technical English I	Communication in English (written, oral) on technical-specialist subjects relating to the professional domain and the workplace.	Be able to communicate in English at both written and oral level using a specific language and terminology specific to the sector of reference.	Method: Written test multiple choice and oral interview in a foreign language. Criteria: The student will have to correctly demonstrate technical terminology, grammatical and syntactic knowledge, as well as fluency in language conversation.	Classroom: 40 hours Individual study: 60 hours	4
	Arrange, negotiate and develop activities in working groups to tackle problems, propose solutions, help produce, order and evaluate collective results.	Team Working	Life cycle of a team; motivation, role of team leader; team building; Team management; management of critical issues and conflicts; performance management (outdoor methodology at IAL Campus in Cervia - Cooking in a commercial kitchen and in the classroom; Orienteering in the city).	Identify leadership styles and interpret the main motivational dynamics that favour active participation of the members in a working group.	Method: Practice Test. Criteria: Placed in a team working situation, the student will have to demonstrate collaboration skills, listening and proposing solutions.	Classroom / laboratory: 16 hours Individual study: 14 hours	1
General Scientific and technological field	Use statistical tools and models in the description and simulation of the different phenomenologies of the reference area, in the application and development of the appropriate technologies.	Mathematical analysis and descriptive statistics	Numbers - elementary operations, calculation algorithms, factorization, fractional and decimal representation, absolute value. Equations and proportions. Elements of algebra: polynomials, equations and systems of algebraic and irrational equations, inequalities and systems of inequations. Elements of analytical geometry and descriptive statistics.	Use calculation functions and mathematical expressions, tools and statistical models.	Method: Written test with business case analysis. Criteria: Starting from a given business case, the student will have to demonstrate an ability for calculation functions.	Classroom / laboratory: 30 hours Individual study: 45 hours	3

	Use tools and methodologies specific to experimental research for the application of technologies in the sector.	Chemistry of materials	Amorphous and semi-crystalline solids; polymeric materials: chemical structure and microstructure, deformation and decomposition mechanisms. Composite materials: matrix and fibres; introduction to solid state and metallic materials; ceramic materials.	Identify materials and recognize their chemical composition as well as their characteristic properties.	Method: Exercise with case analysis. Criteria: The student must correctly demonstrate an ability to interpret characterization tests of materials suitable for testing their structural behaviour, performance and specific characteristics.	Classroom / laboratory: 28 hours Individual study: 32 hours	2
General Legal and economic field	Know the relevant rules governing the company and its external relations at national, European and international level.	Intellectual property rights	Designs, models, brands and patents.	Know legislation relating to trademarks and patents.	Method: Written test multiple choice. Criteria: The student must demonstrate knowledge of trademark and patent laws.	Classroom / laboratory: 4 hours Individual study: 9 hour	0,5
General Management organizational framework	Manage relationships and collaborations within the organizational structure within the work contexts, evaluating their effectiveness.	Communicate and relate to work	Negotiation situations and techniques conflict management; lean productions relationships.	Apply negotiation and conflict management techniques.	Method: Oral exam through simulations and role playing. Criteria: The student must demonstrate the use of effective communication techniques and / or negotiation and management of potentially conflicting situations.	Classroom / laboratory: 12 hours Individual study: 18 hours	1
	Manage external relationships and collaboration - interpersonal and institutional - evaluating their effectiveness.						
	Recognize, evaluate and resolve conflict situations						

	and work problems of different nature: technical, operational, relational and organizational.						
	Know, analyse, apply and monitor, in specific contexts, management models of production processes of goods and services.	HSE model	Integrated Health - Safety - Environment management system.	Apply company regulations and procedures for the prevention of accidents and the safeguarding of health and safety conditions in the workplace, effectively managing general and specific risks.	Method: Multiple choice test Criteria: The student must demonstrate knowledge of the HSE model of integrated risk management.	Classroom / laboratory: 16 hours Individual study: 24 hours	1,5
		Business organization	Organizational planning, the corporate value chain, relationships and organizational actors.	Analysing company logics with a view to efficiency, innovation, optimization of the use of resources, creation of added value, alignment between strategic choices and operating methods.	Method: Multiple choice test. Criteria: The student will have to demonstrate knowledge of business organization models.	Classroom / laboratory: 12 hours Individual study: 18 hours	1
Common Made in Italy Technological area - Mechanical system	Develop and implement design, manufacturing and prototyping techniques.	Reading and interpreting technical drawings	UNI and ISO standards; paper formats, definitions and principles regarding technical drawings, types of lines, units of measurement, dimensional scales; axonometries, orthogonal projections, sections, cross-hatching, dimensioning, tolerances, interpretation and reading of the ply book.	Being able to interpret the mechanical technical drawing.	Method: Exercise with case analysis. Criteria: The student must demonstrate that he correctly interprets the conventional set of lines, symbols and other indications on function, shape, size, workmanship and material related to a specific object.	Classroom / laboratory: 24 hours Individual study: 16 hours	1,5

	Drawing and design with 2D and 3D CAD systems	2D and 3D drawing; solid works: creation of parts and assemblies; specific tools for sheet metal, welding, surface creation and moulding; file management, libraries; rendering; simulation, control and validating projects.	Be able to create a 2D and 3D drawing using CAD systems.	Method: CAD practice test. Criteria: The student will have to demonstrate an ability to create parts and assemblies.	Classroom / laboratory: 58 hours Individual study: 24 hours	3,5
	Fundamentals of mechanical design and resistance of metallic materials	States of tension and deformation, tension, compression; effect of thermo-mechanical processes on the structural characteristics of metallic materials.	Recognize the effect of thermo-mechanical processes on structural characteristics of metallic materials.	Method: Exercise with case analysis. Criteria: The student will have to correctly demonstrate an ability to check fatigue strength of metal parts starting from their structural characteristics.	Classroom / laboratory: 36 hours Individual study: 20 hours	2
Identify the materials, the relative processes and the treatments suitable for the various uses.	Characterization of composite materials	Structure and characterization techniques of the main chemical-physical, mechanical and technological properties for use; nature of matrices and types of fibres.	Know the characteristics of composite materials.	Method: Exercise with case analysis. Criteria: The student will have to correctly demonstrate an ability to interpret characterization tests of materials suitable for testing their structural behaviour, performance and specific characteristics.	Classroom / laboratory: 22 hours Individual study: 12 hours	1,5
	Investigation and control techniques on materials	Chemical-physical checks and non-destructive checks.	Apply test techniques to verify the strength of materials.	Method: Exercise with case analysis. Criteria: The student must correctly demonstrate an ability to perform fatigue	Classroom / laboratory: 12 hours Individual study: 8 hours	1

					strength verification of composite materials starting from their structural characteristics.		
		Material properties	Physical properties (coefficient of thermal expansion, density, etc.) Chemical (corrosion resistance ...). Mechanical (tensile strength, compression strength, resilience, hardness, etc. Technological (malleability, ductility, fusibility, weldability, etc.). Tensile test, hardness tests, resilience test.	Know how to choose materials based on their characteristics.	Method: Multiple choice test. Criteria: The student will have to demonstrate an ability to recognize the characteristics and properties of different materials.	Classroom / laboratory: 16 hours Individual study: 12 hours	1
	Choose processing technologies and the relative machines on the basis of the technical-economic characteristics required.	Materials processing techniques	Cutting and removal; deformation without cutting: moulding, extrusion, drawing, rolling; jointing and assembly; primary production and secondary forming processes; treatments and finishing; production process of composite materials.	Know and apply machining technologies in the mechanical area.	Method: Exercise with case analysis. Criteria: The student will have to correctly demonstrate an ability to select processing techniques for the production of metal, polymeric and composite components.	Classroom / laboratory: 42 hours Individual study: 20 hours	2,5

	Research and apply the technical and safety regulations of the electrical, electronic and mechanical sector in the design and use of components.	Machinery directive (2006/42 / CE) and FMEA methodology	Standards: UNI EN ISO 14121-1 Safety of machinery. Risk assessment and ISO/TR 14121-2 Safety of machinery. Risk Assessment. FMEA methodology.	Apply fault prevention, analysis and diagnostics methodologies on systems and plants and propose possible solutions.	Method: Exercise with case analysis. Criteria: The student will have to correctly demonstrate an ability to apply techniques of analysis and fault diagnostics.	Classroom / laboratory: 10 hours Individual study: 12 hours	1
	Manage production flows in their programming, control and cost-effectiveness, also in relation to the logic of industrialization and continuous improvement. Intervene in all segments of the supply chain from production to marketing. Manage post-sales and maintenance needs.	Production planning models and industrial accounting	Types of production; pull and push systems; main and operational production plan; scheduling; order management; budgeting, analysis and determination of intermediate cost configurations, full cost and sale price.	Plan, manage and control production while managing operating costs.	Method: Exercise with case analysis. Criteria: The student will have to correctly demonstrate an ability to set up a production schedule based on cost configurations.	Classroom / laboratory: 30 hours Individual study: 18 hours	2
	Programming industrial automation systems (PLC, robots, CNC machines, communication networks, monitoring and diagnostics systems, etc.). Configure, calibrate, document and maintain automatic systems of different types.	CNC machine programming	Tool card and machine preparation; address programming, CAD-CAM, customized; ISO Standard language Creation of moulds with CAD-CAM-CNC chain process; machining programs for surfaces on CAM stations.	Program the prototype and finished parts processing machines. CNC programming the mechanical manufacturing of mould construction.	Method: Practical programming test. Criteria: The student will have to correctly demonstrate an ability to draft an ISO language program for machine tool processing.	Classroom / laboratory: 36 hours Individual study: 18 hours	2

Specific skills of the job	Recognize materials, processing technologies and related machines on the basis of the technical-economic characteristics required.	3D printing and additive manufacturing technologies	3D printing. Additive manufacturing technologies and materials characterization. Stereolithography (SLA), modelling for deposition of molten material (FDM), selective laser sintering (SLS), selective laser fusion (SLM).	Know and use additive manufacturing technologies.	Method: Exercise with case analysis. Criteria: The student will have to correctly demonstrate an ability to select additive manufacturing technologies for the production of parts and components.	Classroom / laboratory: 28 hours Individual study: 16 hours	2
		Design of moulds and components in composite materials	Mould classification and choice; 3D CAD design: solid and surface modelling; 3D mild definition; verification of the mathematical model; drafting.	CAD 3D design of moulds.	Method: CAD practice test. Criteria: The student will have to demonstrate an ability to perform solid and surface modelling of a mould.	Classroom / laboratory: 36 hours Individual study: 18 hours	2
		Construction of moulds and components in composite materials	Creation of moulds with CAD-CAM-CNC chain process; machining programs for surfaces on CAM station; adjustment, assembly and finishing; mould manufacturing processes for components in composite materials; mould forming and polymerization techniques.	CNC programming the mechanical manufacturing of mould construction. Recognize technologies for mould forming. Select and apply techniques for mould forming.	Method: Practical programming test Criteria: The student will have to demonstrate an ability to draw up a machining program on a CAM station for the construction of moulds.	Classroom / laboratory: 48 hours Individual study: 22 hours	3
INTERNSHIP I			Alternatively, the following curricular objectives can be considered eligible: a) referable to skills common to the mechanical system (indicatively for 200 h/stage) with reference to: 2D and 3D drawing and design (AutoCAD and SolidWorks); classification, characterization, investigation / control and processing of materials; production planning and industrial accounting;	Develop a greater awareness of a personal study path, consolidating the knowledge acquired in the classroom phase.	Method: Observation and verification of the intern's performance by evaluating their effective exercise of knowledge and skills. Self-evaluation and reworking of the experience by the student.	Internship in the company: 380 hours Individual study: 60 hours	18

	machine tool programming CNC; b) referable to the distinctive skills of the figure (indicatively for 180h/stage) with reference to: planning at 3D CAD layout of moulds and CNC programming of mechanical manufacturing of mould constructions		Criteria: The chosen evaluation will include an evaluation judgment of the company tutor and subsequent feedback with the student's self-evaluation by the agency's educational. The result of the combination of hetero and self-evaluation constitutes the summary report of the experience, which will be one of the objects of the final exam		

Total hours in classroom/laboratory in year I: 592
Total internship hours in year I: 380 hours
Total sum of hours in year I: 972

Year II

Area/ Range	Competence objectives for national classification/ standard	Module	Main contents	Learning outcomes of the unit	Methods and criteria for verifying results	Learning methodologies, contexts and related workload (hours)	ECTS credits
General Linguistic, communicative and relational field	Use technical English (micro language), related to the technological area of reference, to communicate correctly and effectively in the contexts in which is required. Manage the communication and relational processes inside and outside the organization both in Italian and English.	Technical English II	Communication in English (written, oral) on technical-specialist subjects relating to the professional domain and the workplace.	Be able to communicate in English at both written and oral level using a specific language and terminology specific to the sector of reference.	Method: Written test multiple choice and oral interview in a foreign language. Criteria: The student will have to correctly demonstrate technical terminology, grammatical and syntactic knowledge, as well as fluency in language conversation.	Classroom: 32 hours Individual study: 48 hours	3
	Prepare technical and regulatory documentation that can be managed through the telematic networks.	Documentation and technical manuals	Use and maintenance booklets; technical assistance manuals; process manuals; spare parts catalogues; expanded drawings; instruction and training manuals.	Recognize the documentation and technical manuals.	Method: Exercise with case analysis Criteria: The student must correctly demonstrate an ability to interpret conventional set of drawings and instructions relating to the use and maintenance of a machine	Classroom / laboratory: 8 hours Individual study: 12 hours	1

	Assess the implications of information flows with respect to effectiveness and efficiency of the management of production or service processes, also identifying alternative solutions to ensure quality.	Analysis, use and protection of digital data	Introduction to complex predictive models (inferential statistics and nonlinear systems) based on nonlinear data sets, raw data and large amounts of data to reveal relationships and dependencies and make predictions of results and behaviours. Presentation of analysis and data mining tools with emerging technologies based on cloud computing and distributed computing: Hadoop, MapReduce and NoSQL databases Data protection: General regulation for the protection of personal data n. 2016/679 and the data protection organizational structure. Corporate network and data protection plan: device configuration, backup and cybersecurity processes against the dangers of device theft and cryptolocker virus.	Analyse, manage, interpret big data and open data. Know and apply the right level of protection to the data (Reg. EU 679/2016 - GDPR). Know and adopt different copyright and license rules to apply to data, digital information and content. Apply different behavioural rules and know-how in the use of digital technologies and in the interaction with digital environments.	Method: Open-ended questionnaire. Criteria: The student must describe the application potential of complex predictive models based on large amounts of non-linear data and the use function of data protection systems in the company.	Classroom / laboratory: 16 hours Individual study: 12 hours	1
General Legal and economic field	Know the relevant rules governing the company and the impact for the company in a territorial context. Use negotiation strategies and techniques with reference to the market in which companies in the sector also operate to strengthen their image and competitiveness.	Innovation management	Deming Cycle and PDCA approach to process management; Statistical and managerial tools. ISO quality standards - Management systems. Management and diffusion of innovation in the company. Technology portfolio management. Organizational learning; agreements, contracts, licenses.	Know and apply procedures envisaged for the management of company processes. Know how to manage, promote and protect company quality and innovation.	Method: Written test with business case analysis. Criteria: Starting from a given business case, the student must demonstrate an ability to develop an improvement program by formulating performance indicators.	Classroom / laboratory: 20 hours Individual study: 30 hours	2

General Organizational and management environment	Know and help to manage the quality organizational models that encourage innovation in companies in the sector.	Statistics and real data analysis	Covariance, correlation, regression (least squares method), linear interpolation. Series chaining. Chi square test.	Use statistical methods in experimental reports and in the analysis of real data.	Method: Written test with business case analysis. Criteria: Starting from a given business case, the student will have to demonstrate how to use descriptive statistics and quantitative analysis techniques applied to the analysis of real cases.	Classroom / laboratory: 14 hours Individual study: 20 hours	1,5
	Analyse, monitor and control production processes in order to formulate proposals/identify solutions and alternatives to improve efficiency and performance of the technological and personnel resources used with a view to continuous improvement.	Control techniques and improvement of production processes	ISO standards for performance improvement and techniques for continuous technology improvement. Test design (DOE).	Apply data analysis techniques for continuous performance improvement.	Method: Written test with business case analysis. Criteria: Starting from a given business case, the student will have to demonstrate that how to use the quantitative analysis techniques applied to measure performance.	Classroom / laboratory: 16 hours Individual study: 24 hours	1,5
	Organize and independently manage the work environment, the personnel and the reference technological system in order to achieve expected production results	Communication and leadership in corporate organizations	Assumption of risk, determination, responsibility and resilience in working practices	Know how to self-evaluate personal work style by recognizing a leadership's aptitudes	Method: Practice test simulation Criteria: As part of a structured exercise, the student will have to demonstrate recognition of the different leadership styles	Classroom / laboratory: 16 hours Individual study: 24 hours	1,5

		Elements of project management	Project plan and planning toolboxes; Planning and scheduling of results: work breakdown structure (WBS); Composition/breakdown of activities/productions (ABS, Activity Breakdown Structure/PBS Product Breakdown Structure); Assignment of responsibilities (compared to the OBS, Organizational Breakdown Structure); Sequencing and scheduling of activities (GANTT, PERT, CPM).	Apply methodology and tools of Project Management in planning and managing work.	Method: Practice test simulation. Criteria: In the context of a structured exercise, the student will have to demonstrate and apply different planning toolboxes.	Classroom / laboratory: 12 hours Individual study: 18 hours	1
Common Made In Italy Technological area - Technical system	Develop and implement design, manufacturing and prototyping techniques.	Fundamentals of mechanical design and resistance of metallic materials II	Strength criteria, impact and fatigue design, surface damage.	Recognize the effect of thermo-mechanical processes on the structural characteristics of metallic materials.	Method: Exercise with case analysis. Criteria: The student will have to correctly demonstrate fatigue strength of metal parts starting from the working effect on their structural characteristics.	Classroom / laboratory: 40 hours Individual study: 20 hours	2,5
		Parametric solid modelling	3D CAD modelling software; basic primitives; construction for extrusion and revolution, simple and advanced; Boolean operations; chamfers and fillets.	Use parametric solid modelling techniques through the use of CAD systems.	Method: CAD practice test. Criteria: The student will have to demonstrate an ability to perform solid parametric modelling.	Classroom / laboratory: 48 hours Individual study: 16 hours	2,5

	Choose processing technologies and the relative machines on the basis of the technical-economic characteristics required.	Integrated product-process design techniques	Product and process integrated engineering techniques and applications: concurrent engineering, estimate of manufacturing costs and their reduction; materials manual and manufacturing cycles; production layout; assembly equipment, product-process matrix; traceability systems with active and passive tags; focus green: eco-design solutions, promote product repair, reuse and recyclability right from the design phase (for recycling).	Apply integrated product - process design techniques (integrated and concurrent engineering).	Method: Exercise with case analysis. Criteria: The student must correctly demonstrate and apply manufacturing instructions contained in the materials manual.	Classroom / laboratory: 28 hours Individual study: 12 hours	1,5
	Identify materials, the relative processes and treatments suitable for various uses. Apply fault prevention, analysis and diagnostics methodologies on systems and plants and propose possible solutions.	Simulation techniques applied to the design of materials	Multiphysics simulation and focus on parametric analysis of properties on materials. Static and dynamic structural analysis with FEM methodology; discretization and creation of the calculation grid; coded primitives; basic/form functions and their combination for the solution of stress-deformation problems.	Apply Multiphysics simulation techniques. Apply the finite element method.	Method: CAD practice test. Criteria: The student must demonstrate an ability to perform Multiphysics simulation on the properties of materials.	Classroom / laboratory: 32 hours Individual study: 12 hours	1,5
		Characterization of materials for additive manufacturing	The materials for additive manufacturing: chemical-physical, mechanical and technological properties; "Net Shape and Near Net Shape Materials"; new materials as a key for optimizing process costs and reducing time to market.	Identify materials, the relative processes and treatments suitable for various uses in the additive manufacturing processes.	Method: Practical exercise on the PC. Criteria: The student will have to correctly demonstrate a lamination plan and the subsequent polymerization and special processing phases.	Classroom / laboratory: 20 hours Individual study: 8 hours	1

		Characterization and structural analysis of laminates	Chemical-physical, mechanical and technological properties for the use of composite materials; structural sizes and optimization of components made of polymer-laminated composite material; micromechanical analysis, elastic and resistance properties of the unidirectional foil.	Apply laminate analysis methods for structural component optimization.	Method: Practical test in an equipped test laboratory. Criteria: The student must correctly demonstrate and apply test techniques of mechanical, elastic and resistance properties of a foil.	Classroom / laboratory: 24 hours Individual study: 8 hours	1
		Investigation and control techniques on materials II	Thermography, endoscopy, magnetometry, ultrasonic tests.	Recognize and apply non-destructive investigation techniques on composite laminates.	Method: Practical test in an equipped test laboratory. Criteria: The student must correctly demonstrate and apply the investigation and control techniques on materials.	Classroom / laboratory: 28 hours Individual study: 12 hours	1,5
	Configure, calibrate, document and maintain automatic systems of different types.	Advanced Manufacturing: Industrial ICT and Smart Integration	Industrial ICT: multidirectional communication between process-product. Smart Integration: horizontal/vertical integration of information along the value chain of the entire production process. Sensors and automatic data identification systems (AIDC). Structural integration of sensors (Data Sensing, Data Processing and Data Communication).	Recognize enabling technologies of Smart Manufacturing Interfacing with the different levels of the IT infrastructure of the factory for supervision and data acquisition control. Recognize and manage the functionality of the sensors integrated into components made of composite for data acquisition, structural monitoring and activation of controls.	Method: Exercise with case analysis. Criteria: Starting from a business case, the student must demonstrate an ability to identify enabling technologies of the digital factory, correctly interpreting its functionality.	Classroom / laboratory: 16 hours Individual study: 8 hours	1

Specific skills of the job		Design of components in composite material	Rolling plan; calculation of the thickness, size and orientation of the packages; stacking sequence; cure cycles for the polymerization of the laminate; notch effects and joints in composite structures; special gluing process.	Design composite components, know and program the phases from lamination to polymerization with particular attention to special bonding processes.	Method: Practical exercise on the PC. Criteria: The student will have to correctly demonstrate a lamination plan and the subsequent polymerization and special processing phases.	Classroom / laboratory: 42 hours Individual study: 18 hours	2,5
		Forming and polymerization techniques for composite materials	Cure cycle and parameters: uniformity, time, temperature, pressure, resin flow; cutting of prepregs; sizing and positioning of the bags for vacuum treatment; autoclave positioning; mould extraction. Focus green: management of production waste containing carbon fibres, sustainable disposal and recovery systems.	Select and apply preforming and polymerization technologies by autoclave bag moulding and closed moulding (infusion, compression moulding, resin transfer moulding, filament winding and braiding).	Method: Practical exercise in the laboratory. Criteria: The student will have to demonstrate an ability to apply bag moulding techniques in an autoclave.	Classroom / laboratory: 84 hours Individual study: 24 hours	4,5
		Design for Additive Manufacturing (DFAM)	Virtual performance analysis; topology and shape optimization, performance maximization; synthesis of shape, size, hierarchical structure and composition of the material; undercuts, variable thicknesses, deep channels and complex/unlimited geometry; reduced number of parts and direct production assembled; break-even point according to the production volume.	Design CAD models of innovative parts and products to be made with additive manufacturing technologies.	Method: CAD practice test. Criteria: The student will have to demonstrate modelling parts for additive manufacturing.	Classroom / laboratory: 52 hours Individual study: 20 hours	3

		Additive manufacturing technologies	Selective laser sintering (SLS), electron beam fusion; three-dimensional printers; databases of interoperable 3D business models; optimization of the 3D model in production.	Realize innovative parts and products through the use of additive manufacturing technologies (laser and electron beam) and three-dimensional printers	Method: CAD practice test. Criteria: The student must demonstrate an ability to draw up an additive manufacturing program starting from the optimization of the 3D model.	Classroom / laboratory: 60 hours Individual study: 16 hours	3
		Experimental design and additive manufacturing	Redesign a part/component and its realization through additive production.	Redesign a part/component and its realization through additive production.	Method: CAD practice test. Criteria: The student will have to demonstrate an ability to design parts and components optimized for 3D printing.	Project Work: 40 hours Individual study: 10 hours	2

INTERNSHIP II	Curricular objectives, referable to the distinctive skills of the figure: a) structural analysis of laminates; b) design of components in composite material; c) forming and polymerization by means of sack moulding in an autoclave; d) forming and polymerization by closed moulding; e) design of parts and products to be made with additive manufacturing; f) use of additive manufacturing technologies	Consolidate technical-specialist knowledge acquired in the course	Method: Observation and verification of the intern's performance by evaluating their effective exercise of knowledge and skills. Self-evaluation and reworking of the experience by the student. Criteria: The chosen evaluation will include an evaluation judgment of the company tutor and subsequent feedback with the student's self-evaluation by the agency's educational. The result of the combination of hetero and self-evaluation constitutes the summary report of the experience, which will be one of the objects of the final exam	Internship in the company: 380 hours Individual study: 100 hours	20

Total hours in classroom/laboratory hours/PW in year II: 648
Total internship hours in year II: 380
Total sum of hours in year II: 1,028

Progression rules (prerequisites)

Successful completion of the first year is necessary to access the second year of the course and only upon obtaining 60 credits.

At the end of the course in year II, the diploma of Advanced Technician is obtained after passing a final test. The diploma stipulates the technological field and the national classification/standard, which allows access to public competitions and universities with the recognition of university credits. The EUROPASS certificate is also issued in Italian and English.

Internship abroad

Participants are given the opportunity to carry out part or the entire internship period in foreign companies. Credits are recognized without any further activity or learning verification being requested from the student.

Flexibility / customization

For all admitted students, REALIGNMENT modules are provided specifically for the topics: Chemistry, Mathematics, Physics, Design and Technology. Realignment is mandatory for all participants. These hours are to be considered in addition to the expected course hours.

Credit calculation criteria

The calculation criterion applied is the following:

1 credit = sum of classroom hours / laboratory / enterprise / internship + individual study hours / 25 hours (except for rounding up).

Course location

ITS MAKER Foundation

Fornovo Taro headquarters (PR)